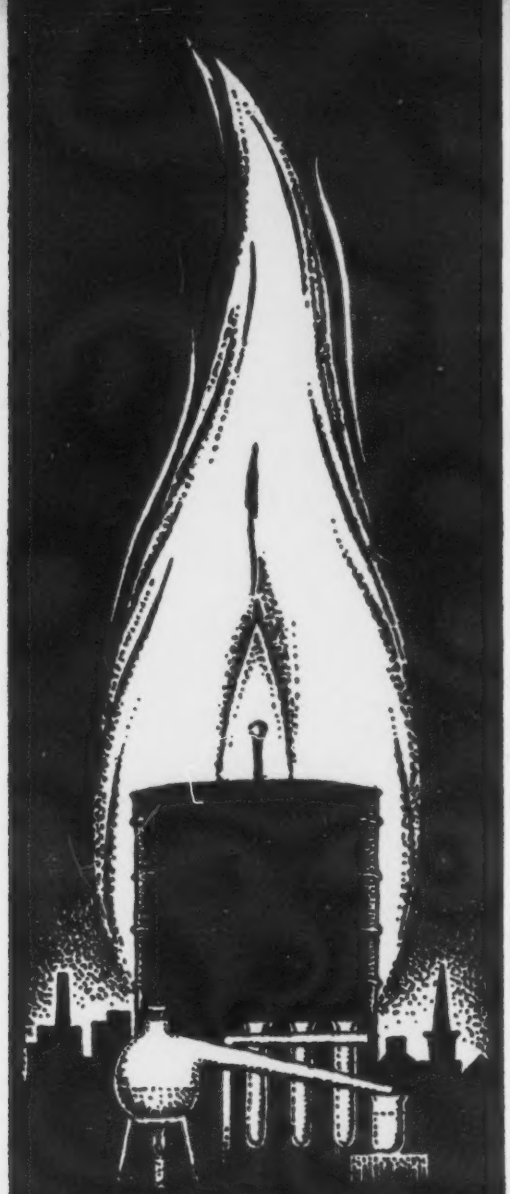

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GAS ABSTRACTS

GAS ABSTRACTS was started in 1945 by the Institute of Gas Technology to survey current technical journals, to select articles pertaining to the Gas Industry, and to prepare abstracts of these articles, stressing their significance to the Gas Industry.

Selection of Articles: Each month the periodicals listed on the last two pages are examined and articles pertaining to the production or manufacture, distribution, transmission or storage, and utilization of natural and manufactured gas and related subjects are selected for abstracting by individual staff members of the Institute of Gas Technology. When possible the significance of the article to the Gas Industry is stressed.

Classification of Abstracts: The abstracts are grouped under twelve headings for presentation and are arranged alphabetically by subject in each group. The headings and subject matter included in each are presented below:

1. The Gas Industry will include general information and news items, statistics, business regulations and other articles of general interest.

2. Appliances - Domestic and Commercial will include burners, ranges, cooking equipment, air conditioning equipment, water heaters and other gas appliances for domestic and commercial use.

3. Combustion and Industrial Furnaces will include combustion of gaseous, liquid and solid fuels; design of industrial furnaces; control of furnace atmospheres.

4. Carbonization and Gasification will include manufacture and purification of producer gas, blue gas, carburetted water gas, synthesis gas; carbonization and gasification of coal; and gasification of oil.

5. Natural Gas and Natural Gas Condensates will include production, transmission, distribution and storage of natural gas and natural gas condensates; distribution of LP-gas mixtures; carbon black and chemicals from natural gas and natural gas condensates.

6. Petroleum and Synthetic Liquid Fuels will include production, refining-cracking, alkylation, isomerization, and utilization of petroleum and production of synthetic liquid fuels by the Fischer-Tropsch reaction and hydrogenation.

7. Analytical Methods and Tests will include new and improved methods pertaining to gas making materials, processes, products, and by-products.

8. General and Physical Chemistry will include data on chemical and physical properties of elements and inorganic compounds; new reactions; and methods for carrying out established reactions.

9. Organic Chemistry will include data on organic compounds closely related to the Gas Industry; new reactions; new methods for carrying out established reactions.

10. Chemical Engineering will include data and methods for fluid flow, heat transfer, and unit operations of distillation, evaporation, extractive drying, and filtration.

11. Process Equipment and instrumentation will include information on new equipment for process operations and process control.

12. Materials of Construction will include new developments in refractories, heat and corrosion resistant materials, new alloys applicable to the Gas Industry, and other materials of construction.

13. New Books will include recent books pertaining to the field of gas technology.

Annual Index: Author and subject indexes will be issued at the end of the year.

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TABLE OF CONTENTS

		PAGE
1.	THE GAS INDUSTRY	1
2.	APPLIANCES - DOMESTIC AND COMMERCIAL	3
3.	COMBUSTION AND INDUSTRIAL FURNACES	4
4.	CARBONIZATION AND GASIFICATION	6
5.	NATURAL GAS AND NATURAL GAS CONDENSATES	9
6.	PETROLEUM AND SYNTHETIC LIQUID FUELS	12
7.	ANALYTICAL METHODS AND TESTS	13
8.	GENERAL AND PHYSICAL CHEMISTRY	14
9.	ORGANIC CHEMISTRY	15
10.	CHEMICAL ENGINEERING	16
11.	PROCESS EQUIPMENT AND INSTRUMENTATION	17
12.	MATERIALS OF CONSTRUCTION	18
13.	NEW BOOKS	19

I. THE GAS INDUSTRY

GASOLINE FROM NATURAL GAS

Keith, P.C. GASOLINE FROM NATURAL GAS. *Am. Gas J.* 164, 11-15 (1946) *June*, *Gas* 22, 21-26 *June*, *Oil & Gas J.* 45, 102-112 *June* 15; *Am. Gas Assoc. Monthly* 28, 253-6 *June*.

The Hydrocol process is an adaptation of the Fischer-Tropsch process which will be employed to convert natural gas to gasoline at Brownsville, Texas, in a plant scheduled for operation late in 1947. The plant will consume 64,000,000 cu. ft. of gas per day and will produce 5800 barrels of motor fuel (octane number 80 CFRM) and 1200 barrels of diesel oil (45-50 cetene number). In addition, 150,000 lb. of crude alcohols will be available. Allowing credits of 3.5¢ per gallon for the diesel oil and 0.5¢ per lb. for the alcohols, the "out-of-pocket" cost of the gasoline is 2.5¢ per gallon; including capital costs for interest, depreciation, and amortization, the cost becomes 5.25¢ per gallon. An interesting feature of the plant is the production of 40,000,000 cu. ft. per day of high purity oxygen (estimated cost of 4.8¢ per 1000 cu. ft.). The reactor employs iron catalyst and utilizes the fluid catalyst. Expenditures for the initial research and development program technique have been about one million dollars. It is stated that the process will place natural gas in competition with crude oil as a source of raw material for the refinery and will set a ceiling of less than $2.00 per barrel for crude oil. On the other hand, 6¢ gasoline from $2.00 per ton coal is not more than two or three years off. A process utilizing oxygen for producing city gas from bituminous coal is currently being investigated.

--C.H. Riesz

L P GAS INDUSTRY

Oberfell, G.G. and Thomas, R.W. THE LIGHTER HYDROCARBONS HAVE TAKEN ON A LOT OF WEIGHT. *Petroleum Refiner* 25, 158-160, 164, 166 (1946) *June*.

The liquefied petroleum gas industry's initial rapid growth has been followed by a period, during war years, of a very healthful consolidation. Growth of the industry, particularly for domestic uses, in 1947 and 1948 should far exceed any previous two year period. There is ample supply of butane and propane for the requirements of motor fuel, aviation gasoline, synthetic rubber, and chemical industries, over and above the requirements of the LPG industry. In fact, the potential supply far exceeds present demands of these industries. Increased cost of production facilities and competition from other industries for the products will, over a period of time, probably increase the cost of propane and certainly increase the cost of butane to the LPG industry. Leveling out the winter-summer ratio is the industry's best assurance of continued satisfactory supply and will serve to delay price increases brought on by competitive industries.

--Author's abstract

I. THE GAS INDUSTRY

NATURAL GAS INDUSTRY

Mayfield, M.L. FUTURE OUTLOOK FOR GAS TRANSMISSION LINES. *Petroleum Engr.* 17, 59-68 (1946) May.

Based on a review of the reserves, the recent war period expansion of transmission lines, and new construction as now announced, the following observations may be made: (1) Proved natural gas reserves are adequate for a reasonable market expansion. This expansion is impendent, for several large transmission lines are taking steps to increase their current capacities. (2) Gas pipe line companies have instituted ratable takes in certain areas and this practice will ultimately receive universal acceptance. In the near future, gas transmission lines will be urged either by public opinion or regulatory authority to take greater quantities of oil well gas in order to reduce current gas wastage to a minimum. (3) The gas transmission business, after a very hectic birth, has become a stable and substantial part of the economic life of the Nation. Its flexibility is limited due to the fugacious or peculiar nature of gas, which cannot move as a commodity but must be delivered from well to consumer when and as needed. (4) The adoption of proper gas well spacing within fields and the growth of gas proration rules promise to become more widespread and necessary in the near future. (5) The development of gathering and improved treating techniques wherein sour or sulphur gas, previously useless and unwanted, will promote and help conserve substantial quantities of gas and increase the availability of such oil well gas to transmission lines. (6) The continued and successive increased demand for natural gas should be an incentive for producers to conserve gas and should bring about a higher price at the wellhead. This may be occasioned by new markets either for carbon black, transmission usage, chemical syntheses for liquid fuels, or for pressure maintenance to attain maximum oil recovery. The possibility of producing gasoline from methane offers a great incentive to the owners of both dry and oil well gas because gas prices can only move under competition or through the law of supply and demand.

--Excerpt from article

PROPANE UTILIZATION

Bludworth, J.E. CHEMICALS FROM LIGHTER HYDROCARBONS. *Petroleum Refiner* 25, 216-219 (1946) May.

A general discussion of possibilities of manufacture of chemicals from lighter hydrocarbons, and particularly propane, is presented. It is pointed out that more is involved than translation of laboratory-learned possibilities into commercial production. Proposal to utilize excess propane in the manufacture of a chemical must be accompanied by consideration of market demand for that chemical, and effect of increased supply on the price.

Author's abstract

2. APPLIANCES - DOMESTIC AND COMMERCIAL

BURNER DESIGN

PRIMARY AIR INJECTION CHARACTERISTICS OF ATMOSPHERIC GAS BURNERS. *Am. Gas Assoc. Testing Laboratories Research Bulletin No, 37, 1-20 (1946).*

New data are presented on the effect of individual elements of burner design on atmospheric injection of primary air. Major burner design factors such as size of throat, port size and depth, slope of injection tube, and ratio of throat to total port are quantitatively analyzed. Values of injection tube slope and length, throat to port area ratio, and position of gas orifice for optimum primary air injection are indicated. Less important variables in burner design are qualitatively discussed. An equation embodying all major factors of burner design and gas characteristics influencing primary air entrainment is developed. A chapter is devoted to the solution of practical problems on air injection by use of this equation. This investigation was conducted as a part of Project DGR-2B and extends the practical knowledge derived from previous research on primary air entrainment in gas burner design, results of which were published in Bulletins Nos. 10 and 26.

3. COMBUSTION AND INDUSTRIAL FURNACES

COMBUSTION OF COAL

Hoffman, I.R. TO IMPROVE COMBUSTION, LET'S IMPROVE THE COAL. *Power Plant Engineering* 50, 71, 86 (1946) April.

Experimental tests on small batches of activated coal show the combustion properties of medium and low grade coals to be much improved by this process. Increased speed of ignition, increased rate of combustion, control of coking, and reduction of clinker formation resulted after addition of 5-10 per cent activated fuel to the coal. Nature of additives and cost of process are not discussed.

R.T. Griffith

COMBUSTION IN INDUSTRIAL FURNACES

McRae, H.C. AIR-GAS RATIO CONTROL APPLIED TO NONATMOSPHERIC-PRESSURE FURNACES. *Trans. Am. Soc. Mech. Eng.* 68, 385-390 (1946) May.

For reasons of economy and efficiency, in the burning of fuel gases in industrial furnaces it is essential to maintain the air-gas ratio at approximately the correct point for perfect combustion. Furthermore it is important to control the ratio of air flow to gas flow because of the effect of burned gases or atmosphere upon material being heat treated. The author discusses in detail the various control processes available, the equipment developed for the purpose and analyzes the several control circuits, basing the work on the laws of low-pressure gas flow or noncompressible flow.

Editor's abstract

RADIANT DRYER

Martin, R. NEW GAS-FIRED PRODUCTION LINE DRYER SAVES TIME, MONEY, LABOR, FOR SOUTHERN CALIFORNIA POTTERY MANUFACTURER. *Gas* 22, 40-42 (1946) June.

Extensive research on two continents has resulted in the development of a radically new type gas-fired black panel radiant dryer which enables ceramic ware to be dried on a production line basis. At the present time, Vernon Kilns, Vernon, California, has the first of these new gas dryers installed and in operation. This new drying equipment has several unique advantages: 1. Production-line drying, 2. Saves plant floor space, 3. Cuts breakage due to handling, 4. Conserves storage space devoted to molds and drying rooms, 5. Cuts drying time cycle, 6. Number of molds needed is only one-sixth needed formerly, and 7. Low operational cost.

Excerpt from article

SMOKELESS COAL DOMESTIC HEATERS

Fellows, J.R. SMOKELESS COAL HEATERS. DEVELOPMENT OF HAND-FIRED HEATERS FOR DOMESTIC USE. *Mech. Eng.* 68, 519-525 (1946) June.

Experience in the laboratory, in research residence, and in more than 100 private homes indicates that a solution has been found for several of the more difficult problems that previously stood in the way of a general use of smokeless hand-fired coal heaters. It appears likely that the inexpensive baffle wall used in the Illinois smokeless furnace will stand up for several years in actual service. It has definitely been proved that puff-back problems can be eliminated with a combination

of good furnace construction and the proper method of controlling the primary coking air. It has also been definitely proved that the average householder can learn to operate a smokeless furnace successfully and that practically every type of bituminous coal can be burned in it. Owing to the extremely severe conditions imposed upon the baffle in the Illinois smokeless furnace and the use of some other parts not previously used in conventional furnaces, the manufacturers who are licenses of the University of Illinois Foundation feel that considerable service experience is necessary before it will be safe for them to manufacture the furnaces in large numbers. It therefore appears to the author that smokeless coal heaters will not be available to the general public in large numbers for the 1946-1947 heating season. However, unless unforeseen problems arise in the meantime, there is every reason to expect that the Illinois smokeless furnace, along with companion stoves and competing stoves will be available in sufficient numbers to fill the demand within the next two years.

Excerpt from article

4. CARBONIZATION AND GASIFICATION

COAL

Fieldner, A.C. and Brewer, R.E. ANNUAL REPORT OF RESEARCH AND TECHNOLOGIC WORK ON COAL FOR THE FISCAL YEAR 1945. *U.S. Bureau Mines I. C. 7352 (1946) April.*

This report is a review of work conducted by the Bureau of Mines on the occurrence, properties, mining, preparation, and uses of coal and coal products, including carbonization and gasification products.

COKING BLENDED COALS

Reynolds, D.A. and Davis, J.D. BLENDING PROPERTIES OF LOW AND MEDIUM VOLATILE COALS AS DETERMINED IN THE BM-AGA APPARATUS. *U.S. Bureau Mines R. I. 3936 (1946) May.*

The results of BM-AGA (Bureau of Mines - American Gas Association) tests at 900°C. of 12 low-volatile, 8 medium-volatile, and 26 high-volatile coals and their blends were analyzed to determine the effects of blending upon the quality of coke and yields of by-products. The low- and medium-volatile coals were blended with 70 and 80 per cent Pittsburgh-bed coal; 5 low-volatile coals were blended with various high-volatile coals in the same proportions. The relative coking power of the individual coals and their blends was determined by comparing the shatter and tumbler indexes of the cokes. The following conclusions were made from this study: 1. The average coking power of medium-volatile coals equals that of low-volatile coals. This equality holds true if they are carbonized separately or as blends with Pittsburgh-bed coal. 2. The most strongly coking medium-volatile coals coke fully as well as the most strongly coking coal of any rank, when carbonized separately. 3. The coking power of medium- and low-volatile coals generally indicates their value as blending coals although anomalous results are sometimes obtained where different high-volatile coals are used. The coking power of binary blends correlates with that of the higher rank coal more closely when medium-volatile coals are blended. 4. Blends of low-volatile coals yield more coke and less tar, light oil, and gas than blends containing equal proportions of medium-volatile coals. The yield of gas on the volume basis is approximately the same for blends of low- and medium-volatile coals.

Excerpt from summary

HYDROGEN PRODUCTION

HYDROGEN BY THE STEAM-HYDROCARBON PROCESS. *Chem. Met. Eng.* 53, *122-3, 162-5 (1946) May.*

For the production of hydrogen by the steam-hydrocarbon reaction the Hygirtol process has been developed by the Girdler Corp. The process consists of: (1) removal of sulfur compounds present in the hydrocarbon gas, (2) hydrogen production from the desulfurized hydrocarbon and steam by means of a nickel catalyst at 1500°F., (3) hydrogen purification by the removal of carbon monoxide and carbon dioxide. The sulfur compounds in the hydrocarbon gas are removed by caustic scrubbing, or at elevated temperatures by conversion of the organic sulfur compounds to hydrogen sulfide over bauxite or metallic oxide catalysts

and subsequent removal of the hydrogen sulfide by caustic scrubbing. The carbon monoxide is removed in two stages: (1) The oxidation of carbon monoxide by steam to carbon dioxide and hydrogen at 750°F. over an iron oxide catalyst. (2) After the carbon dioxide formed in (1) is removed by aqueous amine solutions, e.g. 15% aqueous soltuion of monoethanolamine, the remaining carbon monoxide is removed by catalytic hydrogenation.

F.L. Estes

PACKAGED FUEL FROM ANTHRACITE FINES

Schmidt, L.D., Reid, W.T., Seymour, W., and Myers, J.W. PHYSICAL AND COMBUSTION CHARACTERISTICS OF PACKAGED FUEL CONTAINING ANTHRACITE FINES. *U.S. Bureau of Mines R.I. 3882 (1946) May.*

Results are reported on the practicability of using anthracite fines in the manufacture of packaged fuel. Glen Smith process, ordinarily used in making packaged fuel from Pocahontas screenings, was relied upon to prepare experimental lots. Asphalt binder was used in making blocks from anthracite fines alone and anthracite fines in admixture with bituminous fines. Physical properties and combustion characteristics of the various samples were determined. Physical tests indicated that a packaged fuel of sufficient strength for ordinary handling can be made from straight anthracite fines or from a wide variety of blends of anthracite fines with bituminous coal, using asphalt binder. However the combustion tests indicated that packaged fuel made from anthracite fines alone tended to crumble excessively during burning and that as much as 30 to 50% of a caking coal may be required in the mixture to produce a block having satisfactory combustion characteristics. Smoke produced during the burning of this type of fuel depends principally upon the quantity of asphalt binder used and secondarily upon the type and quantity of bituminous coal in the mixture.

--A.D. Singh

SULFUR REMOVAL

Maxted, E.B. and Priestly, J.J. REMOVAL OF SULFUR COMPOUNDS FROM TOWN GAS BY CATALYTIC HYDROGENATION. *Gas J.* 247, 471-8, 515-6, 556-7, 593 *(1946).*

The experimental work, design and operation of a plant for the conversion and removal of organic sulfur compounds in town gas are described. The process involves the destructive hydrogenation of various organic sulfur compounds by the passage of the gas through various metallic thiomolybdate catalysts. The sulfur compounds are converted into hydrogen sulfide which can be absorbed in conventional purifiers. Tests were made with: (a) purified gas, (b) crude gas, and (c) gas which contained 50-200 grains of hydrogen sulfide per 100 cu. ft. In a typical experiment a purified gas containing 25 grains per 100 cu. ft. of organic sulfur was passed at a space velocity of 470-2850 volumes per volume of catalyst space per hour through a bed of cobalt thiomolybdate catalyst mounted on granular bauxite at a temperature of 400-450°C. After the hydrogen sulfide formed was removed by iron oxide, the outlet gas contained 3.7-6.0 grains of organic sulfur per 100 cu. ft. When a town gas containing 29.8 grains of organic sulfur was passed

over a cobalt thiomolybdate catalyst on bauxite at 400°C. 3.4 grains of organic sulfur per 100 cu. ft. was unconverted. The unconverted compounds were thiophene and carbon oxysulfide. As the hydrogen sulfide content of inlet gas increased, the conversion of organic sulfur compounds decreased. The catalytic sulfur removal plant is placed between the outlet purifier and the inlet benzol plant. In an experimental plant which has been in operation about a year the sulfur content was reduced from 28 to 10 grains per 100 cu. ft. After the gas is passed through the benzol plant the sulfur content was further reduced to 3–6 grains per 100 cu. ft. Details of catalyst preparation and construction and operation of the catalytic sulfur removal plants are included. The total cost of organic sulfur removal was estimated to be 0.239¢ per therm (1.172¢ per 1000 cu. ft.)

--F. Estes

5. NATURAL GAS AND NATURAL GAS CONDENSATES

AMMONIA FROM NATURAL GAS

Mitchell, G.S. AMMONIA, ITS PRODUCTION FROM NATURAL GAS. *Petroleum Refiner* 25, 245-259 (1946) June.

The Lion Oil Co. ammonia plant is described. Natural gas is passed over zinc oxide at 662-752°F. to remove organic sulfur. The purified gas is reacted with steam (100-150% excess) over a nickel catalyst at 1292°F. to produce a primary reformed gas. This gas is mixed with nitrogen-air and passed over a nickel catalyst at 1832°F. to complete the reforming of methane. Carbon monoxide in the gas is converted into hydrogen and carbon dioxide by reaction over a promoted iron oxide catalyst at 977°F. Equilibrium gas compositions are plotted for the primary reforming. Carbon dioxide is removed by scrubbing with water at 230 lb. pressure. Traces of carbon monoxide and oxygen are removed by scrubbing with a "copper liquor" at 1800-1900 lb. pressure and 32-59°F. Carbon dioxide removal is completed by scrubbing with caustic. The purified nitrogen-hydrogen mixture is passed over a promoted iron oxide catalyst at 5000 lb. pressure and 932°F. Water vapor, carbon monoxide, and carbon dioxide are temporary poisons for this catalytic reaction and can destroy the activity of the catalyst in a few minutes so that elaborate precautions are necessary to limit the amounts of these impurities. Nitric oxide is formed by burning ammonia with air over a platinum alloy gauze at 1652°F. This is oxidized with air to nitrogen dioxide in an oxidation tower although further oxidation takes place in the absorption system. A solution containing 56% nitric acid is recovered. Ammonium nitrate is made by reacting ammonia and nitric acid.

—C.H. Riesz

Foster, A.L. PETROCHEMISTRY. DIRECTS NATURAL GAS CONVERSION AT LION OIL CO. PLANT. *Oil & Gas J.* 45, 98-101, 103, 105 (1946) June 22.

A description of the Lion Oil Co. natural gas conversion plant at El Dorado is given. About 22,000 cu. ft. of gas is processed for each ton of ammonia synthesized.

—C. H. Riesz

Note: See preceding abstract.

CONDENSATE RESERVOIRS

Dotterweich, F.H. and Bennett, E.O. TRENDS IN PROCESSING GAS CONDENSATE RESERVOIRS. *Oil Weekly* 121, 25-30 (1946) May 6.

In this paper the authors suggest a tentative method to better evaluate retrograde losses occuring in condensate reservoirs and suggest possible trends which may make available to post war industry a greater quantity of the lighter hydrocarbon fractions by effecting greater economies in the extraction of these fractions from nature's reservoirs.

—Excerpt from article

5. NATURAL GAS AND NATURAL GAS CONDENSATES

GAS CONSERVATION

Foster, A.L. NEW CYCLING PLANT CONSERVES GAS; PRODUCES 300,000 GALLONS OF PRODUCTS DAILY. *Oil & Gas J.* 45, 60-62 75 *(1946) June 1.*

Conservation of the entire raw products of the Sheridan condensate field, Colorado County, Texas, is the purpose and design of the Shell Oil Co., Inc. plant established there. One of the undesirable features of most large oil and gas fields in the past has been the inevitable use of flares in which to burn excess gas which must be produced, also inevitably, with the oil or distillate. The Shell plant at Sheridan has eliminated waste by recovering all the liquefiable products which is practicable, including propane for liquefied petroleum gas, it conserves the stripped gas and makes it do the work of bringing up more distillate, natural gasoline, and liquefied petroleum gas by recompressing the gas and returning it to the formation as a cycling system of operation. In its design the various products are separated and fractionated to the required commercial standard purity. Stripped gas is returned to five input wells arranged according to a preconceived pattern.

—Excerpt from article

GAS RECOVERY FROM CONDENSATE

Davis, W.J. VOLATILE HYDROCARBONS SEPARATED FROM CONDENSATE AT SHERIDAN CYCLING PLANT. *Petroleum Engineer* 17 *103, 106-118 (1946) April.*

The plant is designed to handle a throughput of 100,000,000 cu. ft. of gas and condensate mixture daily from the 10 dual completion wells connected to the gathering system. The wells produce from a 9300 ft. and a 10,300 ft. zone in the Wilcox series. Well pressures in the field averaged 1800 lb. per sq. in. Gas enters the plant at well pressure and no separator is used at the wellhead. Recovery efficiencies are held to 85 per cent minimum for butanes and 99 per cent for isopentane and heavier hydrocarbons, 25 per cent of inlet propane having been incidentally recovered. Purity of isobutane, normal butane, and isopentane is maintained at 95 per cent minimum. Absorption oil is obtained from charge to plant and is held to approximately 35-40 deg. API and a boiling range of 450-640°F. Details of the process and the equipment are given.

MOTOR FUEL FROM NATURAL GAS CONDENSATE

Brown, G.G. CONDENSATE FROM NATURAL GAS YIELDS MOTOR FUEL DIRECTLY. *Natl. Petroleum News* 38, *Tech. Sect. R-436, 438 (1946) June 5.*

Condensate, the new liquid product being produced from natural gas in high-pressure recycling plants, can yield a motor fuel suitable for sale directly to the ultimate consumer. It need not be sold as a blending agent. Condensate is secured in much the same manner as natural gasoline, but has a wider boiling range. Because of this it can be fractionated as desired to secure finished motor fuels of satisfactory volatility without blending. These motor fuels, either standard or premium grade, meet the new federal specifications and are competitive with fuels now sold in certain areas of the country. In addition, they are low in sulfur, free from gum, and have good lead susceptibility.

5. NATURAL GAS AND NATURAL GAS CONDENSATES

VISCOSITY OF NATURAL GAS

Beal, C. THE VISCOSITY OF AIR, WATER, NATURAL GAS, CRUDE OIL AND ITS ASSOCIATED GASES AT OIL FIELD TEMPERATURES AND PRESSURES. *Petroleum Technology, Am. Inst. Min. Met. Eng., Tech. Publ. No. 2018 (1946) March.*

This paper presents useful charts for conversion of various viscosimeter units into centipoises and graphically summarizes published investigations of the viscosity of air, water, and natural gas at high temperatures and pressures. Where possible, charts and correlations were constructed to cover a range of temperature (60°F. to 300°F.) and pressure (14.7 lb. per sq. in. abs. to 8000 lb. per sq. in. gauge) encountered in oil fields. Correlation charts, for the purpose of predicting crude oil viscosity and solubility behavior at oil field temperatures and pressures, were constructed from an analysis and correlation of 1332 viscosity and solubility observations from 953 crude oil samples taken from 747 oil fields. Of these fields, 501 are in the United States, including 75 in California. Of the 1332 observations, 1215 were viscosity values, including 786 of gas-free crude oil, 351 of oil saturated with gas, and 78 under-saturated with gas at pressures above the bubble point. Results show that crude oil viscosity at various reservoir conditions can be predicted with average deviations varying from 24.2 per cent for gas-free crude oil to as little as 2.7 per cent for under-saturated crude oil "above the bubble point." The solubility of crude oil may be predicted from oil gravity and saturation pressure with an average deviation of 22.0 per cent from observed values. In conclusion, it is shown that the viscosity of a gas and gas-saturated crude oil may be predicted within the accuracy of most reservoir computations.

Author's abstract

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

FLUID CATALYTIC CRACKING UNIT

Read, D. A FLUID CATALYTIC CRACKING UNIT FOR THE SMALL REFINER. *Petroleum Refiner* 25, 233-236 (1946) May.

The stages in the development of the present simplified fluid catalytic cracking unit for the smaller refiner are briefly discussed. The principal improvements in efficiency and the mechanical simplifications which have been made are reviewed. The improved method of controlling the new unit results in uniform catalyst flow and smooth operation. This method of control has been tested in the 2600 barrels-per-day commercial unit. The flexibility of the fluid catalytic cracking process has been demonstrated by commercial units, which have processed stocks ranging from naphthas to topped crude at reactor temperatures of 800-1000°F. Various recycling operations and combinations of catalytic and thermal cracking operations have been investigated in both pilot plant and commercial units.

Author's Abstract

SMALL FLUID CATALYTIC CRACKING UNIT. *Petroleum Refiner* 25, 298 (1946) June.

Brief reference is made to the newly announced small capacity cracking unit of The M.W. Kellogg Co. The unit has a daily through-put of 10,000 bbl. of crude. Work is under way on units of lesser capacity, the smallest being 1700 bbl. per day. Savings in height and special equipment have been announced. The new unit has the reactor, regenerator and precipitator all at the same elevation, 69 ft. Improvement in stripping and operating flexibility are claimed.

J.D. Parent

THERMOFOR CATALYTIC CRACKING

Noll, H.D., Holdon, K.G., and Bergstrom, E.V. SIMPLICITY AND FLEXIBILITY OF THERMOFOR CATALYTIC CRACKING. *Petroleum Refiner* 25, 237-243 (1946) May.

A small Thermofor catalytic cracking unit is proposed as one means whereby operators of small refineries may meet the problem of producing higher yields of quality gasoline at a reasonable manufacturing cost, and provide ample allowance for further increases in quality should the competitive situation so demand. A small scale integral TCC unit developed by engineers of Houdry Process Corp. and Socony-Vacuum Oil Co. is discussed. The unit can be designed to process from 1000 barrels per stream day upward of virgin charging stocks ranging from heavy naphthas to vacuum distillates. Its simplicity of design and flexibility of operation make catalytic cracking feasible and practical for operators of small refineries. The unit is characterized by high yields of high-quality product at high liquid recoveries with low investment cost and low operating maintenance costs. The integral design and simplicity of construction details make for a high percentage of on-stream time.

Author's abstracts

7. ANALYTICAL METHODS AND TESTS

CARBURETTED WATER GAS

Shepherd, M. ANALYSIS OF A STANDARD SAMPLE OF THE CARBURETTED WATER-GAS TYPE BY LABORATORIES COOPERATING WITH THE AMERICAN SOCIETY FOR TESTING MATERIALS. *J. Research Natl. Bureau Standards* 36, 313-349 *(1946) March.*

This is a report of the analysis of a standard sample of carburetted water-gas by 24 laboratories in cooperation with Subcommittee VII of Committee D-3 of the American Society for Testing Materials. The data are presented in a series of frequency distribution plots, which show at a glance how the analyses compare with respect to each component of the gas mixture, as well as the calculated heating value and specific gravity. These plots form a clear picture of this type of gas analysis in this country. Although some very creditable work was reported, the need for some standardization is evident.

Author's abstract

FISCHER-TROPSCH CATALYST

Hale, C.H. RAPID ANALYSIS OF FISCHER SYNTHESIS CATALYST. *Petroleum Refiner* 25, 265-268 *(1946) June.*

Cobalt-thoria-kieselguhr is one of the most common catalysts used for the Fischer-Tropsch synthesis of hydrocarbons from carbon monoxide and hydrogen. Cobalt is determined by titrating with potassium ferricyanide to a "dead-stop" endpoint. Thorium is precipitated as the iodate and is determined volumetrically. Kieselguhr is calculated by difference. Details of the procedure, the evaluation of interfering metal ions, and the analysis of known samples are presented.

C.H. Riesz

PARTICLE SIZE DETERMINATION

Frith, F. and Mott, R.A. A RAPID METHOD FOR THE DETERMINATION OF THE SPECIFIC SURFACE AND MEAN PARTICLE SIZE OF BLACK POWDERS. *J. Soc. Chem. Ind.* 65, 81-87 *(1946) March.*

The tinting strength test has been standardized so as to obtain complete dispersion of carbon blacks down to a size of 50 mu (=0.000050 mm.) or less. Standardization of the test has been possible with carbon blacks whose size (within the range of 300 to 30 mu) has been determined by the electron microscope. A discussion of the relationship between surface area and mean particle size for particles which are spherical, cubical, or even slightly prismatic, shows that the method can be used to assess mean specific surface or mean particle size for black powders below 50u (0.050 mm.), that is for sub-sieve sizes. The range of sizes which can be assessed extends to lower limits of size than can be examined by sedimentation tests or microscopical counts. The method has been applied particularly in a study of the fine grinding of coke and coal, and could be applied to other black powders. Its application to white powders should be possible if suitable standards can be chosen from measurements by the electron microscope. The method is simple, requires little equipment and is rapid to carry out when the art has been acquired.

Author's abstract

8. GENERAL AND PHYSICAL CHEMISTRY

EXTINCTION OF GASOLINE FLAMES

Jones, G.W. and Gilliland, W.R. EXTINCTION OF GASOLINE FLAMES BY INERT GASES. *U.S. Bureau Mines R.I. 3871 (1946) April.*

The results presented in this report evaluate the effect of various gaseous inert substances, which, due to their chemical inertness and composition, should be of considerable value in the prevention of gasoline fires and explosions. The report describes the apparatus used, methods of conducting the tests, and results obtained relative to the use of nitrogen, carbon dioxide, automobile-exhaust gas (85% nitrogen + 15% carbon dioxide), dichlorodifluoromethane, trichloromonofluoromethane, and dichloromonofluoromethane in the prevention of gasoline-air explosions. The results are presented graphically so that the user may easily determine the explosion hazards of any given combination of the gases without resorting to laborous calculations, it being necessary only to know the actual composition of the mixture as determined by gas analysis methods. The flame-quenching properties of the various substances tested in connection with gasoline vapor-air mixtures increased in the following order: Nitrogen, exhaust gas, carbon dioxide, dichloromonofluoromethane, dichlorodifluoromethane, and trichloromonofluoromethane, nitrogen being the least effective and trichloromonofluoromethane the most effective on a volumetric basis.

Conclusion to report

HELIUM

Wheeler, H.P., Jr. THE PROPERTIES AND USES OF HELIUM. *U.S. Bureau Mines I.C. 7344 (1946) April.*

The properties of helium and ways in which these properties may be used are reviewed and illustrated by tables. A bibliography of 912 items covering the period 1933-45 is included.

9. ORGANIC CHEMISTRY

HYDROCARBONS - MOLECULAR VOLUMES

Corbin, N., Alexander, M., and Egloff, G. MOLECULAR VOLUMES OF MONONUCLEAR AROMATIC HYDROCARBONS. *Ind. Eng. Chem.* 38, 610-611 (1946) June.

The molecular volumes of 1-phenylalkanes and 2-phenylalkanes at any given fraction of the critical temperature are linear functions of the number of carbon atoms. Molecular volumes of fourteen homologous series of mononuclear aromatic hydrocarbons at 20°C. are also linear functions of the number of carbon atoms. Both of these relationships may be expressed by equations of the form:

$$M/d = V = a + bn$$

Constants a and b are simple functions of the reduced temperature. These functions may be expressed by equations of the form:

$$a \text{ or } b = k + pT_R + qT^2_R$$

Author's abstract

HYDROCARBONS - PHYSICAL CONSTANTS

PHYSICAL CONSTANTS OF PARAFFIN HYDROCARBONS. *Petroleum Refiner* 25, 244 (1946) May.

The Natural Gasoline Association of America standards for the physical constants for paraffin hydrocarbons from methane through decane are presented in tabular form.

HYDROCARBONS - PHYSICAL PROPERTIES

Prosen, E.J. and Rossini, F.D. HEATS OF FORMATION, HYDROGENATION, AND COMBUSTION OF THE MONOOLEFIN HYDROCARBONS THROUGH THE HEXENES, AND OF THE HIGHER 1-ALKENES, IN THE GASEOUS STATE AT 25°C. *J. Research Natl. Bureau Standards* 36, 269-275 (1946) March.

For ethylene, propylene, the four butenes, the six pentenes, and the 17 hexenes, and all the higher 1-alkene hydrocarbons, in the gaseous state at 25°C., values are given for the heats of formation (from the elements solid carbon (graphitic) and gaseous hydrogen), the heats of hydrogenation in the gaseous state, and the heats of combustion (in oxygen to form gaseous carbon dioxide and liquid water). The values for 2 of the pentenes, 14 of the 17hexenes, and all the higher 1-alkene hydrocarbons were calculated by a method involving correlation of the heat of hydrogenation with structure and the use of constants evaluated from the available experimental data on 4 butenes, 4 pentenes, 3 hexenes, and 1 heptene.

Author's abstract

IGNITION TEMPERATURE OF NAPHTHALENE

Jones, G.W. and Scott, G.S. LIMITS OF INFLAMMABILITY AND IGNITION TEMPERATURE OF NAPHTHALENE. *U.S. Bureau of Mines R.I.3881 (1946) May.*

The ignition temperatures of naphthalene in air and in oxygen were found to be 587°C. and 560°C., respectively. The temperature limits of inflammability of air saturated with naphthalene vapor under the prevailing barometric pressures of 746-8 mm. Hg were found to be 77.8°C. and 121.8°C., respectively. With the aid of published vapor pressure data the concentration limits of inflammability were calculated to be 0.88 per cent and 5.9 per cent by volume of vapor in air.

10. CHEMICAL ENGINEERING

DRYING AND PULVERIZING COAL

NEW METHOD OF DRYING AND PULVERIZING COAL. *Industrial Heating* 13, 992 *(1946) June.*

A new method of pulverizing and drying coal, employing a principle similar to that used in the "puffing" of cereals, was described for the first time at the fuels session of the recent Annual Meeting of the American Society of Mechanical Engineers in New York by J.I. Yellott and A.D. Singh. The process was said to be especially well adapted to coal to be used in the open cycle gas turbine. The new pulverizer and dryer operates on the continuous-explosion principle, and contains no moving parts. By simply allowing the coal to pass through a nozzle with steam or air, a high degree of pulverization is accomplished, in much the same manner as liquid fuels are atomized by a similar process. Effective pulverization is obtained with upper pressures of less than 100 psi, and with moderate steam temperatures. Experiments with compressed air indicate that equally effective pulverization is obtained, without the necessity of heating the air. The steam or air enters the minute pores of the coal and, when the coal passes almost instantaneously through the nozzle, thus greatly reducing the outside pressure on the coal, the gas which is trapped in the pores expands and powders the coal. The drying is accomplished simultaneously so that the product is obtained in the form of a fine, dry powder. Fineness of pulverization depends upon pressure drop and the ratio of gas flow to solid flow. The process also offers a promise of a useful application for very large tonnages of wet coal fines which are now useless, because their excess moisture makes it impossible to burn them in conventional equipment.

Excerpt from article

HEAT TRANSFER BETWEEN SOLID AND FLOWING FLUID

Thiele, E.W. MATERIAL OR HEAT TRANSFER BETWEEN A GRANULAR SOLID AND FLOWING FLUID. PRESENT STATUS OF THE THEORY. *Ind. Eng. Chem.* 38, 646-650 *(1946) June.*

This paper is a review of the literature on the material or heat transfer between a granular solid and a fluid flowing through a bed of such solids. No new theory is developed, but the previous literature is listed and the significant features therein contained are summarized. Percolation rather than chemical reaction is considered.

J.D. Parent

SUPER-EXPANSIBILITY OF METHANE-ETHANE MIXTURES

Clinedinst, W.O. SUPER-EXPANSIBILITY OF METHANE-ETHANE MIXTURES. *Petroleum Refiner* 25, 296-7 *(1946) June.*

Super-expansibility flow correction factors are graphically presented for various methane-ethane mixtures at 60°F. and for various mean pressures.

J.D. Parent

II. PROCESS EQUIPMENT AND INSTRUMENTATION

CHAR REVIVIFICATION APPARATUS

Kent, R.S. CHAR REVIVIFICATION APPARATUS. *U.S. 2,400,935 (1946) May 28.*

A process for drying, revivifying and cooling char used in filtration operations is described. Constructional features and arrangement of dryer, revivifier and cooler are discussed for reclaiming of heat from the revivified char to expedite and increase the efficiency of the various processes.

—A.D. Singh

CORROSION INDICATOR

HOW TO LOCATE CORROSION IN REFINERY TUBES. *Petroleum Engr.* 17, 74 *(1946) June.*

A device which indicates thickness of non-magnetic materials is described. It is known as the Shell Probolog and is suggested for locating thin spots in tubular heat exchangers.

J.D. Parent

GAS ANALYZER

Minter, C.C. THE THERMAL CONDUCTIVITY METHOD OF GAS ANALYSIS. *J. Chemical Education* 23, *237-9 (1946) May.*

Since thermal conductivity varies with the percentage of the constituents in a mixture of gases or of gases and vapors, it can be measured to furnish a continuous indication of composition. The Gow-Mac Instrument Co. of Newark, New Jersey, manufactures a unit suitable for the continuous analysis of two component systems by application of thermal conductivity measurements. It is further stated that multi-component mixtures may be analyzed by employing calibrated conductivity units for each constituent. In order to insure accurate results, it is suggested that the relation between the composition of complex mixtures and thermal conductivity be established. The principal advantages of the technique are: (1) Elimination of tedious chemical methods and (2) Continuous indication of composition.

HIGH PRESSURE EQUIPMENT

Caldwell, W.F. AUTOCLAVE FOR VISUAL OBSERVATION OF HIGH PRESSURE REACTIONS. *Ind. Eng. Chem.* 38, *572-575 (1946) June.*

The trend toward high pressure and high temperature chemical reactions has necessitated the development of experimental apparatus which will permit visual observation of conditions during the entire operation. The equipment described indicates how this result is achieved by means of a rotating Jerguson gage with clear glass on two sides through which light may pass. It is housed in an insulated casing, provided with strip heaters for raising the temperature and with glass windows for viewing the temperature and pressure gage. Besides serving as a miniature autoclave, it may be used for determining solubilities in solvents which are volatile at atmospheric pressure and the temperatures obtained. It also permits the determination of solution densities under varying conditions of temperature and pressure.

Author's abstract

12. MATERIALS OF CONSTRUCTION

HIGH TEMPERATURE ALLOYS

Browne, L.E. COBALT BASE HIGH TEMPERATURE ALLOYS. *Steel 118*, 88-90, 132 (1946) May 27.

Outstanding characteristics of these cobalt-nickel alloys, as will be noted by referring to tables included in the article, are their resistance to wear, heat, corrosion and erosion. These alloys are now available commercially in grades that possess high hardness and strength even at red heat; good resistance to creep, high stress-rupture properties, resistance to both atmospheric and chemical corrosion, and in addition have a low coefficient of friction.

Excerpt from article

13. NEW BOOKS

Egloff, G. PHYSICAL CONSTANTS OF HYDROCARBONS. VOL. III. MONONUCLEAR AROMATIC HYDROCARBONS. A.C.S. Monograph 78. New York, Reinhold Publishing Corp., 1946.

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Jones, P.J. PETROLEUM PRODUCTION. VOL. I. MECHANICS OF PRODUCTION: OIL, CONDENSATE, NATURAL GAS. New York, Reinhold Publishing Corp., 1946.

Steacie, E.W.R. ATOMIC AND FREE RADICAL REACTIONS. THE KINETICS OF GAS-PHASE REACTIONS INVOLVING ATOMS AND ORGANIC RADICALS. A.C.S. Monograph 102. New York, Reinhold Publishing Corp., 1946.

Wells, A.F. STRUCTURAL INORGANIC CHEMISTRY. Oxford, The Clarendon Press, 1945.

Zimmerman, O.T. and Lavine, I. PSYCHOMETRIC TABLES AND CHARTS. Dover, New Hampshire, Industrial Research Service, 1945.

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AMERICAN GAS ASSOCIATION MONTHLY

AMERICAN GAS JOURNAL

AMERICAN PETROLEUM INSTITUTE QUARTERLY

AMERICAN SOCIETY FOR TESTING MATERIALS BULLETIN

AMERICAN SCIENTIST

ARCHITECTURAL FORUM

BERICHTE DER DEUTSCHEN CHEMISCHEN GESELLSCHAFT

BITUMINOUS COAL RESEARCH

AST FURNACE AND STEEL PLANT

BRAUNKOHLE *(Microfilm)*

BRITISH CHEMICAL AND PHYSIOLOGICAL ABSTRACTS: SECTIONS A AND B.

BRITISH COAL UTILISATION RESEARCH ASSOCIATION MONTHLY BULLETIN

BULLETIN AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

BULLETIN AMERICAN CERAMIC SOCIETY

BUSINESS WEEK

BUTANE-PROPANE NEWS

CALIFORNIA OIL WORLD

CANADIAN CHEMISTRY AND PROCESS INDUSTRIES

CANADIAN JOURNAL OF RESEARCH: SECTIONS A AND B.

CERAMIC ABSTRACTS

CHEMICAL ABSTRACTS

CHEMICAL AND ENGINEERING NEWS

CHEMICAL AND METALLURGICAL ENGINEERING

CHEMICAL INDUSTRIES

CHEMICAL PREVIEW

CHEMICAL REVIEWS

CHEMIKER ZEITUNG *(Microfilm)*

CHEMISTRY AND INDUSTRY

CHIMIE ET INDUSTRIE *(Microfilm)*

COKE AND SMOKELESS FUEL AGE

COLLIERY GUARDIAN

COMBUSTION

COMPRESSED AIR MAGAZINE

DIE CHEMIE

DOMESTIC COMMERCE

ELECTRONIC INDUSTRIES

ENGINEERING AND MINING JOURNAL

ENGINEERS' DIGEST

FEUERUNGSTECHNIK *(Microfilm)*

FORTUNE

FUEL IN SCIENCE AND PRACTICE

GAS

GAS AGE

GAS AND OIL POWER

GAS APPLIANCE MERCHANDISING

GAS JOURNAL

GAS NEWS

GAS TIMES

GAS-UND WASSERFACH *(Microfilm)*

GAS WORLD

GENERAL ELECTRIC REVIEW

GREAT BRITAIN FUEL RESEARCH INTELLIGENCE STATION ABSTRACTS

HEATING AND VENTILATING

INDUSTRIAL AND ENGINEERING CHEMISTRY: ANALYTICAL EDITION

INDUSTRIAL AND ENGINEERING CHEMISTRY: INDUSTRIAL EDITION

INDUSTRIAL BULLETIN OF ARTHUR D. LITTLE, INC.

INDUSTRIAL GAS

INDUSTRIAL HEATING

INSTITUTION OF GAS ENGINEERS: BULLETINS, COMMUNICATIONS AND TRANSACTIONS

INSTRUMENTS

IRON AGE

JOURNAL OF THE AMERICAN CERAMIC SOCIETY

JOURNAL OF THE AMERICAN CHEMICAL SOCIETY

JOURNAL OF APPLIED MECHANICS

JOURNAL OF APPLIED PHYSICS

JOURNAL OF CHEMICAL EDUCATION

JOURNAL OF CHEMICAL PHYSICS

JOURNAL OF CHEMICAL SOCIETY (LONDON)

JOURNAL OF THE INSTITUTE OF FUEL

JOURNAL OF THE INSTITUTE OF PETROLEUM

JOURNAL OF ORGANIC CHEMISTRY

JOURNAL OF PHYSICAL CHEMISTRY

JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS

JOURNAL OF THE SOCIETY OF CHEMICAL INDUSTRY

LP GAS

MATERIALS AND METHODS (METALS AND ALLOYS)

MECHANICAL ENGINEERING

MINING AND METALLURGY

MINING TECHNOLOGY

PERIODICAL ABSTRACTED FOR GAS ABSTRACTS (CONT'D)

MONTHLY NATURAL GASOLINE REPORT

MONTHLY SUMMARY OF GAS COMPANY STATISTICS

NATIONAL GAS BULLETIN OF AUSTRALIA

NATIONAL PETROLEUM NEWS

NATURE

OEL UND KOHLE

OFFICIAL GAZETTE OF THE U.S. PATENT OFFICE

OIL AND GAS JOURNAL

OIL, PAINT AND DRUG REPORTER

OIL WEEKLY

PETROLEUM

PETROLEUM ENGINEER

PETROLEUM REFINER

PETROLEUM TECHNOLOGY

POWER

POWER PLANT ENGINEERING

PUBLIC UTILITIES FORTNIGHTLY

REFRIGERATING ENGINEERING

ROCKETS

SCIENCE

SCIENCE ABSTRACTS: SECTIONS A AND B

SCIENTIFIC AMERICAN

SOUTHERN POWER AND INDUSTRY

STEEL

TECHNICAL NEWS BULLETIN OF THE NATIONAL BUREAU OF STANDARDS

TRANSACTIONS AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

TRANSACTIONS AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

TRANSACTIONS AMERICAN SOCIETY OF MECHANICAL ENGINEERS

TRANSACTIONS ELECTROCHEMICAL SOCIETY

U.S. BUREAU OF MINES BULLETINS, INFORMATION CIRCULARS, REPORTS OF INVESTIGATIONS AND TECHNICAL PAPERS

WEEKLY ANTHRACITE COKE REPORT

WOODALL-DUCKHAM TECHNICAL PRESS REVIEW

WORLD PETROLEUM

ZEITSCHRIFT FUR ANALYTISCHE CHEMIE *(Microfilm)*

ZEITSCHRIFT FUR ANORGANISCHE CHEMIE *(Microfilm)*

ZEITSCHRIFT FUR PHYSIKALISCHE CHEMIE *(Microfilm)*